

TROPOSPHERIC CALIBRATION FOR THE MARS OBSERVER GRAVITY WAVE EXPERIMENT

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In spring 1993, microwave radiometer-based tropospheric calibration was provided for the Mars Observer gravitational wave search. The Doppler shifted X-band radio signals propagating between earth and the Mars Observer satellite were precisely measured to determine path length variation that might signal passage of gravitational waves. Experimental sensitivity was restricted by competing sources of variability in signal transit time. Principally, fluctuations in solar wind and ionospheric plasma density combined with fluctuations in tropospheric refractivity determined the detection limit. Troposphere-induced path delay fluctuations are dominated by refractive changes caused by water vapor inhomogeneities blowing through the signal path. Since passive microwave remote sensing techniques are able to determine atmospheric propagation delays, radiometer-based tropospheric calibration was provided at the Deep Space Network Uranus tracking site (DSS-15). Two microwave water vapor radiometers, (WVRs) a microwave temperature profiler, (MTP) and a ground based-meteorological station were deployed to determine line-of-sight vapor content and vertical temperature profile concurrently with Mars Observer tracking measurements. This calibration system provided the capability to correct Mars Observer Doppler data for troposphere-induced path variations. We present preliminary analysis of the Doppler and WVR data sets illustrating the utility of WVRs to calibrate Doppler data. This takes an important step toward realizing the ambitious system required to support the future Ka-band Cassini satellite gravity wave tropospheric calibration system.